

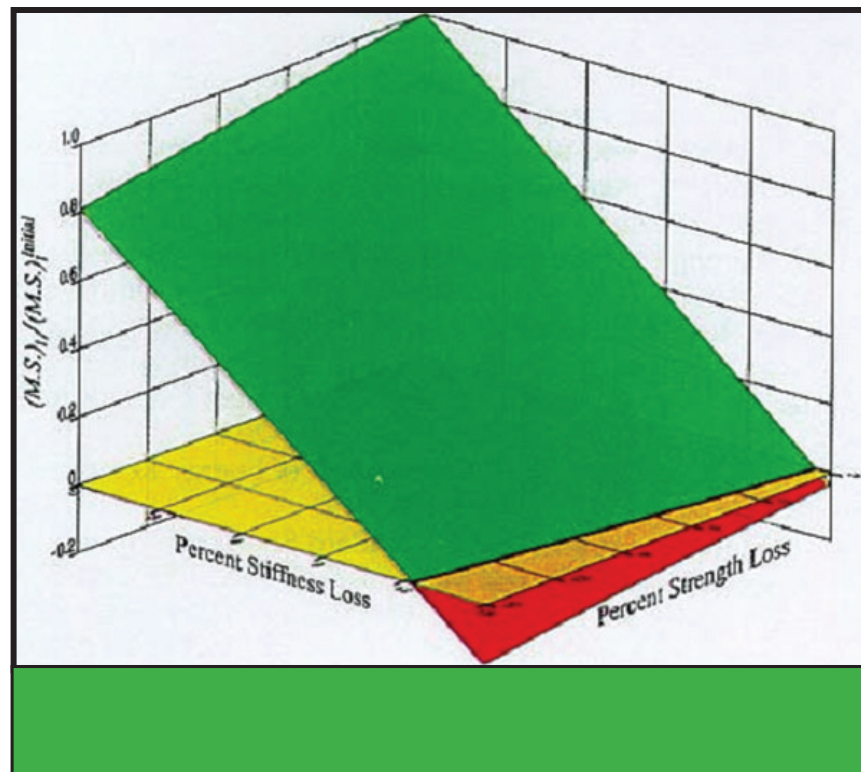


Air Force Research Laboratory | AFRL

Science and Technology for Tomorrow's Aerospace Forces

Success Story

PREDICTING THE REMAINING USEFUL LIFE OF COMPOSITE AIRCRAFT STRUCTURES



Predicting the remaining useful life of composite aircraft components using nondestructive test (NDT) data has operational and economic importance for military and commercial aviation. By accurately identifying the significance and existence of structural deterioration or damage, aircraft maintainers can employ repair resources more intelligently, thus enabling greater efficiency, performance, reliability, and confidence, all at a lower maintenance cost.



Air Force Research Laboratory
Wright-Patterson AFB OH

Materials and Manufacturing
Support to the Warfighter

Accomplishment

Research sponsored and supported by the Materials and Manufacturing Directorate proved the possibility of predicting the residual useful life of advanced composite aircraft structures using NDT data. Aircraft maintainers can apply the analytic framework developed to a broad class of composite aircraft structures to improve the effectiveness and efficiency of composite repair resources and provide substantial reductions in aircraft maintenance costs.

Background

Modern aircraft and aerospace vehicles are heterogeneous structures comprised of complex mixtures of composite and metallic materials. Substandard fabrication procedures, environmental exposure and handling, or service damage can all have a negative impact on the mechanical integrity of these structures without affecting their visual appearance.

In composite structures, material discontinuities can consist of delamination, matrix cracking, fiber fracture, voids, porosity, inclusions of foreign objects, and bond failure. Aircraft maintainers consider periodic characterization by various NDT methods an important aspect of ensuring reliable performance for composite components subject to increasingly demanding structural requirements.

Dr. Jocelyn M. Seng, a directorate scientist and engineer, worked with Dr. Raymond J. Nagem of Boston University, and Dr. James H. Williams, Jr. of the Massachusetts Institute of Technology, to combine NDT data with structural design data. They combined this data with material degradation models to formulate a residual life prediction model for the Harrier Jump Jet's horizontal stabilizer.

The team defined the structural integrity state and operational failure criteria for the stabilizer, and developed an analytical paradigm for predicting its remaining useful life. The analytic framework developed as a result of the project is applicable to a broad class of composite aircraft structures and could lead to more effective, more efficient use of composite repair resources, extended use of composite structures, and substantial reductions in aircraft maintenance costs.

Additional information

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